# Public Comments

| Originating Office: | Document Description:TSO-C16b | Project Lead/Reviewer | Reviewing Office: | Date of Review: |
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| AIR-130 | ELECTRICALLY HEATED PITOT AND PITOT-STATIC TUBES | **Jan Risheim** | | |

| | Commenter | Section # and Page # | Comment | Suggested Change and Rationale | Disposition |
|---|---|---|---|---|---|
| 1. | EASA | Appendix 1 / subsection 2.2.6 Page 7 | We agree that some "*should"* should be interpreted as a "*shall*". Nevertheless, we would propose that all these are replaced by "*shall*" – as required for sections 3.4.2, 3.4.3, 3.4.4, 3.4.11 later in the draft TSO. When this is not a requirement that we want to be mandatory (most, if not all the remaining should are not verifiable), the deviation process should not apply. | Remove the modification of AS8006A for the definition of "*should*". TSO-C16b Appendix 1 modifications of AS8006A to replace "*should*" by "*shall*" are sufficient. | Adopted. Definition of "should" in the appendix removed. |
| 2. | EASA | Several locations in Appendix 1 & 2 Pages 7 to 13 | It looks awkward that the process for a deviation is repeated many times in the text of the TSO, while this is described in AC 21-46 and FAA order 8150. | Clarify that each of these points are considered a deviation to the TSO-C16b. For example, in Appendix 1 page 8 about AS8006 section 4, replace "*Other means to demonstrate compliance may only be applied if an equivalent level of safety is documented, justified, and approved by the FAA as a deviation in accordance with paragraph 3.e of this TSO. Approval must be requested at least 30 days in advance of submitting the TSO application. Additional substantiation may be* | Adopted. |

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| | | | | *required*."<br>by<br>"*Other means to demonstrate compliance are considered a deviation subject to 14CFR 21.618* ." | |
| 3. | EASA | Appendix 1 / subsection 3.4.4<br>Page 8 | The part number should change whenever the equipment is no more interchangeable, even if this is for an aspect not covered by TSO requirements.<br>For example, a change of electrical connector would most probably not affect the TSO performance but would need to be traced by a change of part number | Remove the modification to the AS8006A. | Not Adopted.<br><br>AS8006A paragraph text replaced in Appendix 1 with the following:<br><br>*Design changes to the pitot or pitot static tube shall be made in accordance with 14 CFR § 21.619. Interchangeability at the product (i.e. aircraft) level is determined with respect to the airworthiness regulations (e.g. 14 CFR § part 23, 14 CFR § part 25, etc.) by the installer in accordance with 14 CFR § Parts 21 and 43.*<br><br>The TSO approval holder has responsibility to provide configuration control of the article; |

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| | | | | | however, the TSO approval holder does not have the information necessary to make a determination on interchangeability at the aircraft/product level.<br><br>The installer at the product level must make the interchangeability determination and mandate part number changes if necessary under their supplier control process. |
| 4. | EASA | Appendix 1 / subsection 3.4.11 Page 8 | We did not understood what the change from "*standard"* to "*TSO"* adds in terms of qualification test as AS 5562 is called by AS8006A | Remove the modification to the AS8006A. | Not Adopted.<br><br>The purpose of referencing the "TSO" is to ensure that subsection 3.4.11 qualification test reference is in accordance with the standard as modified by the TSO. |
| 5. | EASA | Appendix 2 / Subsection 3.1.1 Page 11 | The modification of Page 4 fifth paragraph subsection 3.1.1 to replace the reference to 14CFR Part 25, | The resulting text should therefore be:<br>Mixed Phase: Consists of | Adopted. |

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| | | | Appendix D by a reference to 14 CFR Part 25 Appendix C is erroneous. The correct reference should be 14CFR Part 33, Appendix D. | the combination of SLW and IC icing conditions. The liquid phase is taken from the application of 14 CFR Part 25 Appendix C intermittent maximum icing conditions at the standard 2.6 nautical mile horizontal extent. The solid phase is derived by applying a distance scale factor for 2.6 nautical miles to the theoretical adiabatic maximum total water content as defined in 14 CFR Part ***33*** Appendix D. This is done over an altitude range of sea level to that consistent with a static air temperature above -40 °C, as -40 °C constitutes the theoretical minimum temperature for the existence of supercooled liquid water. The temperature range considered shall be -10 to - | |

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| | | | | 40 °C. The MVD and MMD shall be consistent with those used for SLW and IC icing conditions. | |
| 6. | Garmin | 3.<br>Page 1 | It is beneficial when TSOs reference a specific section of the MPS for the requirements of the appliance. | Include a specific requirement section reference to SAE AS 8006A and SAE AS 5562.<br><br>Garmin suggests the following:<br><br>New models of electrically heated pitot and pitot-static tubes identified and manufactured on or after the effective date of this TSO must meet the requirements in<br>Section 3 of the Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8006A, Minimum Performance Standard for Pitot and Pitot Static Probes, Revised August 2015, as | Not Adopted.<br><br>Agree with the commenter that where possible, the specific requirement section should be referenced. All sections of SAE AS8006A and SAE AS5562 are required and the modifications are listed in the appendices. |

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| | | | | modified in Appendix 1 of this TSO, and Section 3 of SAE AS 5562, Ice and Rain Minimum Qualification Standards for Pitot and Pitot-Static Probes, Issued August 2015, as modified in Appendix 2 of this TSO. | |
| 7. S | Garmin | 3.c. Page 2 | In accordance to Order 8150.1C, Technical Standard Order Program, Appendix G, Format and Guidance for the Preparation of a TSO, a TSO should reference a specific section of the MPS for functional qualification test conditions as shown below:<br><br>Demonstrate the required functional performance under the test conditions specified in {insert reference to section of MPS} | Use the guidance text in Order 8150.1C, Technical Standard Order Program, Appendix G, Format and Guidance for the Preparation of a TSO and include a specific functional qualification section reference to SAE AS 8006A and SAE AS 5562.<br><br>Garmin suggests the following:<br><br>"Demonstrate the required functional performance under the test conditions specified in SAE AS 8006A, Section 4, as modified in Appendix 1 of this TSO, and | Not Adopted.<br><br>Agree with the commenter that where possible, the specific requirement section should be referenced. All sections of SAE AS8006A and SAE AS5562 are required and the modifications are listed in the appendices. |

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| | | | | SAE AS 5562, Section 4, as modified in Appendix 2 of this TSO." | |
| 8. | Garmin | 3.c.<br>Page 2 | Editorial: There are two periods at the end of the paragraph. | Remove a period. | Adopted. |
| 9. | Garmin | 3.d.<br>Page 2 | In accordance to Order 8150.1C, Technical Standard Order Program, Appendix G, Format and Guidance for the Preparation of a TSO, a TSO should reference a specific section of the MPS for environmental qualification test conditions as shown below:<br><br>Demonstrate the required performance under the test conditions specified in {insert reference to section of MPS} using standard environmental conditions and test procedures appropriate for airborne equipment. | Use the guidance text in Order 8150.1C, Technical Standard Order Program, Appendix G, Format and Guidance for the Preparation of a TSO and include the specific environmental qualification section reference to SAE AS 8006A and SAE AS 5562.<br><br>Garmin suggests the following:<br><br>"Demonstrate the required performance under the test conditions specified in SAE AS 8006A, Section 5, as modified in Appendix 1 of this TSO, and SAE AS 5562, Section 5, as modified in Appendix 2 of this TSO, | Not Adopted.<br><br>Agree with the commenter that where possible, the specific requirement section should be. All sections of SAE AS8006A and SAE AS5562 are required and the modifications are listed in the appendices. |

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| | | | | using standard environmental conditions and test procedures appropriate for airborne equipment." | |
| 10. | Garmin | 3.g<br>Page 2 | Including this specific DO-254 reference is redundant to the rest of the paragraph in this section.<br><br>For custom airborne electronic hardware determined to be simple, RTCA/DO-254, paragraph 1.6 applies.<br><br>DO-254 makes it clear how to address "simple" custom airborne electronic hardware. | Remove this reference to DO-254 Paragraph 1.6. | Not Adopted. |
| 11. | Garmin | 4.b.(2)<br>Page 3 | Paragraph 4.b.(2) states:<br>Each subassembly of the article that you determined may be interchangeable.<br><br>This language is confusing. This could mean that a stuffed printed circuit board needs the TSO number.<br><br>This language has been removed from draft 8150.1D, Technical Standard | Suggest removing section 4.b. to comply with the soon to be adopted 8150.1D language to eliminate any confusion. | Adopted. |

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| | | | Order Program, Appendix G, Format and Guidance for the Preparation of a TSO, paragraph 4. | | |
| 12. | Garmin | 4.a.(3)<br>Page 2 | Section 3.5.4 of SAE/AS 8006A includes the statement to mark the unit with:<br><br>a. name of instrument,<br>b. rated voltage,<br>c. manufacturer's part number,<br>d. weight,<br>e. manufacturer's serial number,<br>f. date of manufacture, and<br>g. manufacturer's name or trademark, or both.<br><br>The Order 8150.1C TSO template does not include a statement similar to this phrase. | Exclude section 3.5.4 in paragraph 4.a of the TSO.<br><br>Garmin is routinely granted deviations from TSO requirements to mark the equipment with lengthy text as the equipment does not have sufficient space to include this as well as all other required markings (e.g., multiple TSOs and SW level, etc. that appear in other TSOs). This deviation is granted through use of a marking similar to the example in Order 8150.1C ¶ 7-4.e.(4).(b) "See Inst Mnl for Addtl TSO approvals and/or markings."). | Not Adopted.<br><br>The marking requirements are directly from AS8006A.<br><br>A deviation maybe requested in accordance with *14 CFR § 21.618 if* needed. |
| 13. | Garmin | 5.a<br>Page 3 | The application data requirements for a manual do not align with the template in 8150.1C. | Realign numbered items such that they match the Order 8150.1C TSO template to be consistent | Adopted. |

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| | | | | with other TSOs. | |
| 14. | Garmin | 5.f.<br>Page 4 | Paragraph 5.f states:<br><br>f. Identify functionality or performance contained in the article not evaluated under paragraph 3. of this TSO (that is, non-TSO functions). Non-TSO functions are accepted in parallel with the TSO authorization <u>but are not approved</u>. For those non-TSO functions to be accepted, you must declare these functions and include the following information with your TSO application:<br><br>The underlined text is not in the TSO template in Order 8150.1C Appendix G. 8150.1C and 8110.4C clearly state that non-TSO functions are not approved, therefore this is unnecessary and not part of the template. | Remove "but are not approved" from 5.f. | Not Adopted.<br><br>Non-TSO functions are accepted but are not approved. Applicants must identify non-TSO functions to assist installer with integration at the aircraft/product level. |
| 15. | Garmin | 5.k<br>Page 5 | This section is not in the TSO template of 8150.1C. It is not clear why this | Remove section 5.k. | Not Adopted. |

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| | | | TSO requires a compliance matrix when other TSOs do not include this requirement. | | The compliance matrix provides clarity on how the applicant meets the requirement of the TSO (e.g., SAE AS 8006A and SAE AS 5562 as modified in the Appendices of TSO-C16b). This requirement has been included in other TSOs. |
| 16. | Garmin | 6.<br>Page 5 | There are no manufacturer data requirements for software and/or airborne electronic hardware similar to other TSOs. The template in 8150.1C includes optional sections for DO-178 and DO-254 which are included earlier in the TSO, therefore it would be assumed that manufacturer data requirements for these should be included as well. | Add sections similar to below (taken from Order 8150.1C), updated appropriately for DO-178C:<br><br>g. If the article includes software, the appropriate documentation defined in RTCA/DO-178B including all data supporting the applicable objectives in RTCA/DO-178B Annex A, Process Objectives and Outputs by Software Level.<br><br>h. If the article includes complex custom airborne | Adopted. Added "g".<br><br>If the article includes software, the appropriate documentation defined in RTCA/DO 178B or RTCA/DO-178C specified in paragraph 3.e of this TSO; including all data supporting the applicable objectives in RTCA/DO 178B, Annex A, Process Objectives and Outputs by Software Level.<br><br>h. If the article includes complex custom airborne |

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| | | | | electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO-254, Appendix A, Table A-l. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records, including problem reports | electronic hardware, the appropriate hardware life cycle data in combination with design assurance level, as defined in RTCA/DO 254, Appendix A, Table A-l. For simple custom airborne electronic hardware, the following data: test cases or procedures, test results, test coverage analysis, tool assessment and qualification data, and configuration management records; including problem reports.<br><br>Existing g. was modified to "i". If the article contains non-TSO function(s), you must include in your TSO submittal items 6.a through 6.h. as they pertain to the non-TSO function(s)."<br><br>Added the following under |

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| | | | | | 4. Marking, "b'. If the article includes software and/or airborne electronic hardware, then the article part numbering scheme must identify the software and airborne electronic hardware configurations. The part numbering scheme can use separate, unique part numbers for software, hardware, and airborne electronic hardware." |
| 17. | Garmin | 7.a. | Editorial. Missing period at the end of the paragraph. | Add a period. | Adopted. |
| 18. | Garmin | 7.c. Page 6 | This section requires the test report to be provided to the installer to support installation. Garmin does not believe it is necessary to provide this report to the installer to support their installation. The test report can contain a considerable amount of information that is both unnecessary to the installer and proprietary/confidential to the | It is suggested that this section be removed to adhere to the 8150.1C TSO template. Section 7.a. ensures that "any other data needed for the proper installation…of the electrically heated pitot and pitot-static tubes" is provided. | Adopted. Remove Section 7.c.<br><br>Change last sentence of section 7.a. to "Add any other data needed for the proper installation (i.e. data identified in subsection 4.1, 4.5, and 4.10 of AS5562), certification, use, or for |

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| | | | manufacturer. | | continued compliance with the TSO, of the electrically heated pitot and pitot-static tubes." |
| 19. | Garmin | Appendix 1 Page 7 | The TSO redefines the term "SHOULD" improperly. The redefinition essentially identifies all instances of "should" as a "shall" or a requirement that must be met or must be granted a deviation from the FAA. This redefinition complicates and confuses what a "shall" in the document means and whether it can be deviated.<br><br>It also should be noted that RTCA's Program Management Committee, which includes an FAA representative, approved the following text to be included in their Minimum Operational Performance Standards when defining "should":<br><br>"*Should* – **Meaning**: Refers to a performance or test procedure recommendation that, although not mandatory, is considered good | Garmin recommends that all instances of "should" be taken as a recommendation that does not require an FAA approved deviation. SAE committees should have been aware of this terminology and should not have required a justification for deviating from a recommendation.<br><br>From the examples below, AS 8006A used "should" as loose considerations and it is difficult to comprehend why an approved FAA ELOS would be required:<br><br>"The probe design should consider the effects of ingested solid particles such as ice, sand and dust." | Adopted.<br><br>Definition of "Should" has been removed. |

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| | | | industry practice. **Impact to Design**: Although not necessary to meet performance requirements, could result in a deficiency to the end user or installation problems if not followed."<br><br>Neither the AS8006A definition nor the proposed Appendix 1 definition are consistent with the RTCA definition that FAA has agreed with. | "The probe should incorporate design features to minimize the potential for misinstallation on the aircraft."<br><br>"The probe should be constructed and finished to the standards of best commercial practice."<br><br>If a specific "should" needs to be identified as a requirement, then Appendix 1 needs to identify each paragraph that is to be changed to a "shall".<br><br>Appendix 1 should also make it clear to disregard the sentence, "Deviation from the specified recommendation shall require justification", from subsection 2.2.6. | |
| 20. | Garmin | Appendix 1 Table - Section 4 Page 8 | Appendix 1 and 2 have modified the standard text in several instances with the following:<br><br>*... an equivalent level of safety is documented, justified, and approved by* | Suggest that these sections be removed or modified to clearly state that deviations to test methods which meet or exceed the intent of the | Not Adopted.<br><br>The italicized text has been modified as the result of a different comment. |

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| | | Appendix 2 Table – Section 1/Page 1 Page 10<br><br>Appendix 2 Table – Section 3/Page 5 Discussing Section 3.2 Page 11-12<br><br>Appendix 2 Table – Section 3/Page 5 Discussing Section 3.3 Page 12<br><br>Appendix 2 Table – Section 3/Page 5 Discussing Section 3.3.1 Page 12 | *the FAA as a deviation in accordance with paragraph **3.e** of this TSO. Approval must be requested at least 30 days in advance of submitting the TSO application. Additional substantiation may be required.*<br><br>This requires the applicant to obtain a deviation approval from the FAA if the test method is deviated in any way.<br><br>This is inconsistent with previous information provided to Garmin by the FAA. Garmin has previously been denied deviations to test methods with the argument that so long as the intent of the test method is met, there is no requirement to deviate from exact test methods specified in the MPS. | MPS are not required.<br><br>Garmin's understanding is that the TSO and any associated standard defines the requirements <u>of the article</u>. The test procedures listed are a means of verifying the performance of the appliance, and those means may be accomplished by alternate procedures so long as they meet or exceed the intent of the defined qualification test. Alternate means of testing that meet or exceed would not need a deviation and an associated ELOS. | However, **<u>any</u>** variance from the TSO minimum performance standards (including test procedures) must be approved under the deviation process defined in *14 CFR § 21.618*. |

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| | | Appendix 2 Table – Table 5/Page 15 Discussing Note 3 Page 12-13<br><br>Appendix 2 Table – Table 6/Page 15 Discussing Note 2 Page 13 | | | |
| 21. | GAMA | 3.c Page 2 | There is an extra period at the end of the paragraph. | Delete the extra period for proper grammar. | Adopted. |
| 22. | GAMA | 5.h<br>5.i | Adding processes and their revision to the list of data needed for a TSO application and providing periodic updates of the revision level of the process places an additional burden on the applicant and the FAA. | Remove the requirement to provide a list of processes and their revision from each paragraph. (Keep the requirement the same as TSO- C16a, par 5.k. | Not Adopted.<br><br>The requirements reflect the current TSO template. However, the POC of FAA Order 8150.1 has been notified for consideration in the next revision of the template. |
| 23. | GAMA | 5.a 5 Page 4 | List of replaceable components, by part number, that makes up the electrically heated pitot and pitot-static | Change from: ‘makes up’, to: ‘make up’<br>Rationale: proper grammar | Adopted. |

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| | | | tube. | | |
| 24. | GAMA | App 2, section 2.3 | SHALL and MUST are defined, but SHOULD is not. This is inconsistent with App 1, 2.2.6 (page 7) of the draft TSO update where SHOULD is defined. | For consistency, add the same definition for SHOULD from Appendix 1, section 2.2.6 to Appendix 2, section 2.3.<br><br>Also, the TSO change should be shown in italics to be consistent with the rest of the TSO document. | Not Adopted. |
| 25. | GAMA | App 2, section 3, 3.1.1 | Solid phase is defined in 14 CFR Part 33 Appendix D. | Change "14 CFR Part 25 Appendix C" to "14 CFR Part 33 Appendix D".<br>If reference is correct, please specify the specific figure to be used.<br>Also, the TSO change should be shown in italics to be consistent with the rest of the TSO document. | Adopted. |
| 26. | GAMA | TSO 3b | This paragraph requires a failure condition classification to be determined for all Pitot and Pitot-static probes in the intended installation. This cannot be done consistently for | Delete the last sentence or clarify that this paragraph only applies to Pitot and Pitot-static probes that contain software within | Not Adopted.<br><br>The TSO specifically states that the failure condition is dependent on the intended |

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| | | | Pitot and Pitot-static probes because there is no defined process to arrive at a classification as there is for software (DO-178 et.al.). | them. | use for a particular installation. The TSO approval holder is responsible to document the malfunction and failure condition classification to which the article is designed. That information is then available to the installer to support installation approval.<br><br>The expectation is that the TSO approval holder will coordinate with their customers and develop the design to support the intended installations. |
| 27. | Textron Aviation | All | The FAA continues to release TSO requirements that take exception to and/or add to industry standards that we understood the FAA had representatives involved in the standard. It would be helpful if the FAA could provide a justification for each deviation from the industry | Add a brief explanation for why each deviation from the standard is required to assure safety and compliance. | Not Adopted.<br><br>SAE International is a for-profit industry standards development organization. The standards are developed by industry for industry's use. The FAA modifies the standards, as |

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| | | | standard so that we can better understand why such changes and additions are necessary. This way we could work towards have standards that can actually be used as written. | | needed, to fit our specific needs and incorporate them into the TSO system.<br><br>Generally, FAA representatives attend SAE meetings as consultants and are available to answer questions or provide information related to FAA policy and regulations. However, the FAA does not dictate or control the content of SAE International standards. |
| 28. | | | Section 3 of AS5562 is modified as noted:<br>Page 4, replace the fifth paragraph subsection 3.1.1 with the following text to modify an incorrect reference to 14 CFR Part 25, Appendix D:<br><br>The change shows | "The solid phase is derived by applying a | Adopted. |

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| AIR-130 | ELECTRICALLY HEATED PITOT AND PITOT-STATIC TUBES | Jan Risheim | | |

| | Commenter | Section # and Page # | Comment | Suggested Change and Rationale | Disposition |
|---|---|---|---|---|---|
| | Textron Aviation | Page 11, Appendix 2 | "The solid phase is derived by applying a distance scale factor for 2.6 nautical miles to the theoretical adiabatic maximum total water content as defined in14 CFR Part 25 Appendix *C"*<br><br>But the solid phase (i.e. ice crystals) are defined by the theoretical maximum total water content in Part 33 Appendix D, Part 25 Appendix C defines the liquid water content of a cloud, so shouldn't the reference be to Part 33 Appendix D instead? | distance scale factor for 2.6 nautical miles to the theoretical adiabatic maximum total water content as defined in14 CFR Part 33 Appendix *D"* | |
| 29. | James McNamara/ NASC | Section # 3 Page # 1 Section # 3c Page # 2 Section # 3d Page # 2 | Society of Automotive Engineers is no longer the title of the organization. SAE document numbers include the two letter type designation with no space before the number. | Change "Society of Automotive Engineers (SAE) Aerospace Standard (AS) 8006A" to "SAE International (SAE) Aerospace Standard AS8006A". Change "AS 5562" to "AS5562". | Adopted. |
| 30. | James McNamara/ | Section # 4 Page # 3 | SAE document numbers include the two letter type designation with no space | Change "AS 5562" to "AS5562". Change | Adopted. |

# Public Comments

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| AIR-130 | ELECTRICALLY HEATED PITOT AND PITOT-STATIC TUBES | **Jan Risheim** | | |

| | Commenter | Section # and Page # | Comment | Suggested Change and Rationale | Disposition |
|---|---|---|---|---|---|
| | NASC | | before the number. | "AS 8006A" to "AS8006A". | |
| 31. | Thales | Page 11 | For clarification, please precise which figure of CFR Part 25 Appendix C from which the solid phase should be derived. | | Partially Adopted.<br><br>The CFR was incorrectly referenced in AS5562 and Appendix 2 of the proposed TSO. The correct reference has been added to Appendix 2, page 11 – *14 CFR Part 33 Appendix D* |